FOREST INSECT AND DISEASE MANAGEMENT / evaluation report

The Effect of Application Timing on Efficacy of Orthene® Forest Spray Against the Gypsy Moth in Pennsylvania–1976

By:

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Introduction

The gypsy moth, *Lymantria dispar* L., has defoliated millions of acres of forested land in the northeastern United States, leading to tree mortality and changes in stand composition (Kulman 1971, Stephens 1971, Campbell and Valentine 1972).

Since 1947, aerial applications of DDT, Sevin®[1] and Dylox® were used to suppress high-density gypsy moth populations and to contain isolated outbreaks (USDA 1976). Previous field trials have determined that acephate applied as Orthene® Forest Spray will also effectively control gypsy moth populations and reduce the amount of defoliation (Herbaugh et al. 1975, LOTEL 1975).

This study[2] sought to confirm the efficacy of acephate under operational conditions and to determine the effect or earlier- or later-than-normal applications on the degree of gypsy moth control. Treatments were applied to populations in the 1st and 2nd instar, to 4th and 5th instar, and at the "normal" time when the majority of larvae were in the 3rd instar. The reductions in egg mass density, larval populations, and defoliation were compared with populations and defoliation on unsprayed areas.

Methods

The study was conducted on twelve 35-acre blocks located on mountain ridges of upland oak in the Tiadaghton State Forest, Clinton County, Pennsylvania. Efficacy data were collected from ten 1/40-acre subplots in each block. Three blocks were treated with 0.5 lb a.i./acre acephate at each of the timing intervals: early, or when the majority of larvae were in late 1st instar; normal, or 3rd instar populations; and late, after the majority of larvae had reached late 4th or early 5th instar. Three blocks were left untreated.

A Cessna AgPickup® equipped with standard spray booms and pressurized spray system was used to apply the formulation. Fourteen No. 5 round cone nozzles were used; the spray parameters are listed in table 1. Each of the applications was identical except for the gypsy moth population density treated.

The criteria used to determine effectiveness of treatments were protection of foliage and reduction in gypsy moth populations. Foliage protection was determined by estimating the degree of defoliation. Population reduction was measured by comparing differences between 1975 and 1976 egg mass numbers, and from 10-minute counts of larval populations. The specific variables measured in the 1/40-acre subplots were:

1. Defoliation—The amount of defoliation before and after treatment was estimated in 1% increments for each tree larger than 3 inches DBH. To minimize sampling bias, the same teams estimated defoliation both before and after treatment on a given plot.
2. Egg Mass Density—Egg mass density was determined by counting the number of egg masses visible at four levels on trees larger than 3 inches DBH (ground, upper and lower bole, crown) and on debris and trees smaller than 3" DBH. Numbers of egg masses before spraying were counted in November 1975 and post-spray counts were made in November 1976.
3. Larval Density—Larval density was determined from 10-minute counts of all visible larvae along five transect lines in each block. Counts were made one day before spraying, and 2, 4, 8, 12, and 16 days after. The counts were made simultaneously on treatment and control blocks on each sampling date.

The maximum and minimum temperatures and 24 hour precipitation were recorded from May 8 to June 19.

Results

Larval mortality was apparent in the acephate treatment blocks within 24 hours with large numbers of dead larvae visible on trails and roads. The early and late applications resulted in better than a 50% decrease in larval numbers within 2 days. The effect of the normal treatment exhibited a 4- to 8-day delay. Sixteen days after the early treatment, the larval populations were reduced by an average of 99%, while the normal and late treatments showed 75% and 88% average reductions, respectively (table 2).

Treatment also provided foliage protection, regardless of application timing (table 3). Less than 6 percent additional defoliation occurred after application, compared to an increase of 74% on the untreated blocks.

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[1]Use of trade, firm or corporation names in this paper is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

[2]The work reported herein was funded in whole or in part by a U.S. Department of Agriculture sponsored program entitled "The Expanded Gypsy Moth Research and Development Program." U.S. Forest Service Cooperative Agreement No. 42-197.

Table 1.—*Insecticide application parameters*

Nozzle type	(14) #5 round cone
Mounting	30° forward
Pressure	45 psi
Nominal Application Rate	1.0 gallon/acre
Concentration	0.6 lb ai/acre
Carrier	water, with 0.5% Nigrosine dye
Air Speed	95-100 mph
Swath width	75 ft
Height of flight	15-25' above tree tops
Air Temperature	52-68° F

Table 2.—*Number of larvae before and after spraying*[a]

Treatment	Day						Percent Decrease[b]
	-1	+2	+4	+8	+12	+16	
Early	289	14	5	3	3	2	99
Control	222	118	120	149	259	317	
Normal	110	115	131	43	34	32	75
Control	259	263	304	320	291	306	
Late	160	62	38	29	27	25	88
Control	291	289	258	248	268	385	

[a] Based on 10-minute larval counts
[b] Abbott's formula

Table 3—*Foliage protection provided by spraying gypsy moth larvae with acephate at three different times*

Treatment Timing	Percent Defoliation		Net Increase	Percent[a] Foliage Protection
	Before	After		
Early	16	21	5	69**
Normal	21	20.5	0.5	74**
Late	24	30	6	68**
Control	10	84	74	—

[a] Net control defoliation minus net treatment defoliation.
** Highly significant difference (1%).

Table 4.—*Number of egg masses per acre before and after spraying*

Treatment	Before	After	Percent Decrease
Early	3025	1455	52 *
Normal	2964	1567	47 *
Late	2900	1569	46 *
Control	2790	1930	31

*Significantly different from control (5%).

The average egg mass reduction in the treatment blocks was 48% and is statistically different from the control at the 5% level of confidence (table 4). The average number of egg masses in the control blocks decreased 31%, indicating a possible population reduction in the entire study area.

Weather conditions following the early and late applications were seasonably mild with daytime temperatures in the 70s and 80s with minimal rainfall. The normal application was followed by 10 days of cold rainy weather. The temperatures ranged in the 60s to low 70s and 3.95 inches of rain fell during the 10 day period (table 5).

Table 5.—*Temperature and precipitation*

Date	High	Low	Rain	Date	High	Low	Rain
May				May			
8	71	37	0	30	—	—	—
** 9	62	33	0	31	—	—	—
10	72	32	0	June			
11	82	40	0	1	67	—	1.83[a]
12	73	43	.32	2	68	51	1.32
13	64	31	0	3	71	48	0
14	75	31	0	4	75	47	0
15	83	48	0	5	79	47	0
16	75	42	0	6	79	47	0
17	73	—	1.65	7	73	49	0
18	77	57	.04	** 8	81	51	0
19	59	38	.53	9	69	55	.07
20	54	37	.05	10	72	53	0
21	78	42	.52	11	76	56	.09
22	76	41	0	12	79	55	0
23	65	39	0	13	74	54	0
**24	73	37	0	14	69	58	0
25	68	40	0	15	83	59	.23
26	65	43	.77	16	91	64	.03
27	60	45	.03	17	88	65	.46
28	76	45	0	18	83	57	0
29	—	—	—	19	89	57	0

[a]Total of previous four days.
**Indicates spray days.

Discussion

The effectiveness of the acephate treatments in reducing gypsy moth populations and protecting foliage was demonstrated.

The most noticeable result of the acephate treatments was the reduction in larval populations. The early and late applications resulted in marked decrease within 2 days of application. The effect of the normal application was delayed 4 to 8 days. The delay was probably due to reduced larval feeding activity brought on by the cold rainy weather following application. Acephate is principally a stomach poison that must be ingested to be effective.

Acephate prevented further defoliation in all treatment blocks. In the treated blocks defoliation ranged between 20 and 30% while the average final defoliation for the controls was 84%.

Despite the drop in egg mass densities on the control plots, there was still a significant difference between treatment and control areas (table 4). The periodic larval counts in the control area increased erratically during the entire observation period. This indicated that if there was a virus-induced collapse, it occurred in the pupal stage. The 31% drop in egg mass densities in the controls may also have been due to wind blown dispersal of larvae out of the blocks, or other natural causes such as increased predation in these high-density areas.

The principal objective of this study was to determine the effect of application timing on insecticide efficacy. The results indicate that none of the treatments reduced the gypsy moth populations or defoliation substantially more than the others. Therefore, it makes no difference when the insecticide is applied, offering more flexibility in operational spray programs. Although there was no significant difference between applications, the early application resulted in less total defoliation (21%) and reduced the larval populations earlier and more completely than the

later sprays. At the time of the early application, oak foliage was less than 50% expanded and maple foliage was less than 20% expanded. The preferred treatment strategy should be an early application against 1st instar larvae. With this strategy, if unforeseen delays common in large-scale spraying operations occur, efficacy will be relatively unaffected. It would also prevent caterpillar populations in sensitive areas such as public parks, by allowing treatment before most open for the season.

No difficulties were encountered in the mixing and loading operations. Acephate, formulated as Orthene® Forest Spray, is extremely soluble in water, and did not precipitate even at temperatures below 45°F. Vigorous agitation was not required.

Pesticide Precautionary Statement

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

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